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Innovation performance and embeddedness in networks: evidence from the Ethiopian footwear cluster

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Abstract

This study focuses on innovation in a cluster of informal shoemaking firms in Ethiopia – namely the Mercato footwear cluster. It examines how differently those firms are embedded in networks and how heterogeneous they are in absorptive capacity, and how this heterogeneity affects their innovation performance. Business interactions with buyers, suppliers and other producers are the major channels through which knowledge flows into the cluster. These business networks are mainly built on trust and long-term relationships and tend to be selective. The study reveals that despite homogeneity in social background the firms in the cluster behave and perform differently. Based on econometric analysis we document a positive and strong effect of local network position and absorptive capacity on innovation performance.

Key words: industrial clusters, networks, innovation performance, informal sector, Africa, Ethiopia

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1. Introduction

Industrial clusters, customarily defined as geographical agglomeration of firms, are believed to generate collective efficiency, a competitive advantage derived from local external economies and joint action (Schmitz, 1999). They have also been recognized as loci of knowledge generation and diffusion and praised for their role serving as innovative milieus particularly for small firms in developing countries (Camagni, 1991). The collective efficiency model which focuses on the *meso* level (i.e. taking cluster as a unit of analysis) has been the workhorse analyzing the benefits of clustering. As a result, most existing empirical studies focus on contrasting with the Italian district model (Schmitz, 1989; Rabellotti, 1997), testing the presence of collective efficiency in a cluster, explaining why firms that are part of industrial clusters tend to perform better than isolated ones (e.g. Visser, 1999, Schmitz, 1999), or comparing clusters with different characteristics, for example dynamic clusters versus stagnating clusters (e.g. Schmitz and Nadvi, 1999; McCormick, 1999, Knorringa, 2002, van Dijk and Sverrisson, 2003).

A widely accepted notion in this tradition of research is that geography matters and firms equally benefit from the presence of external economies and opportunities for joint action in the cluster. There is an implicit assumption of homogeneity among firms in the cluster. Cluster firms are characterized as small and medium-sized firms with a strong relatively homogenous culture and social background sharing a common and widely accepted behavioral code, and connected through market and non-market linkages (Rabellotti, 1997).

Recent studies, however, contested this belief. Some economic geographers argue that spatial proximity per se is not sufficient to generate learning, and that other forms of proximity (e.g. cognitive, organizational, social, institutional) are required for inter-firm learning and innovation to occur (Boschma, 2005; Capello and Faggian 2005). Others have criticized the traditional view that cluster firms are homogenous (e.g. Lazerson and Lorenzoni, 1999; Giuliani and Bell, 2005; Giuliani, 2005; Boschma and Wal, 2007). Two main sources of heterogeneity that might lead to differential innovation performance among cluster firms have been emphasized in this emerging literature. (i) Despite the usefulness of networks as a vehicle of knowledge, in most clusters such collaborative networks do not include everyone to the same degree. (ii) Similar to those located outside clusters, there is a wide difference among cluster firms in their knowledge base, hence, different levels of absorptive capacity.

These studies also pointed out the need to shift the focus of analysis from meso- to micro (firm)-level as this might give useful insights on the dynamics of clusters.

As far as we know, few studies (e.g. Giuliani, 2006 on wine clusters in Chile and Italy; Boschma and Wal, 2007 on footwear cluster in Italy) attempt to verify empirically the impact of firm heterogeneity regarding embeddedness in networks and absorptive capacity on innovation performance in clusters based on micro-level data. The objective of this paper is, therefore, to contribute to this thin literature by providing empirical evidence based on recently collected firm level data in a cluster of informal shoemaking firms in Addis Ababa, Ethiopia – namely the Mercato footwear cluster. According to Sonobe, Akoten, and Otsuka (2006) this cluster is an exceptionally successful case in Africa that recently have made a remarkable recovery from the intense competition of imported Chinese shoes. Its resurgence was mainly a result of endogenous upgrading efforts by the cluster firms. Understanding the learning and innovation process in this cluster of small and informal firms is, therefore, interesting on its own. More specifically, the paper tries to address the following questions. (i) What type of collaborations and networks do exist in the cluster and how important are each of them for knowledge sharing? (ii) What are the main mechanisms and sources of innovation and learning in the cluster? (iii) To what extent do firms in the cluster differ in their embeddeness in existing networks and absorptive capacities and how do such differences (if they exist) impact innovation performance of firms?

Unlike the above cited studies, this paper relies on data from a cluster of small and informal firms in a less developed country. We adopt a broader definition of innovation to reflect the fact that innovation in small firms in developing countries is largely imitative; an adoption of a product, process or method that has already been developed elsewhere (Van Dijk, 2002). The current study also differs from the previous ones in its characterization of networks. The main focus of the previous studies was on knowledge networks (internal or external to the cluster) arguing that unlike business networks, knowledge networks are built on a more selective basis and are more unevenly distributed. Hence, knowledge networks but not business interactions are the source of heterogeneous innovation performance among cluster firms (Giuliani, 2005). In contrast, this study explores the role of different proximities, which include business and social networks on interactive learning and innovation in the cluster.

This is because, (a) unlike their counterparts in the advanced world, clusters of small firms in developing countries, such as our case, have limited or no external linkages with knowledge

institutions or international technology leaders. They mainly rely on informal relations with their business partners, buyers and suppliers (Von Hippel and Tyre 1995 and Utterback, 1994) and social gathering, family or kinship ties (Howells, 2002) for gaining information and knowledge about innovations. The implication is that in such clusters knowledge networks may not stand alone but are embedded in business or social networks. (b) Similar to knowledge networks, particularly business networks might be selective as they are often based on trust of one kind or another, thus, constitute a source of differential innovation performance. The importance of trust can particularly be observed in relation to credit and technology diffusion in clusters (van Dijk, and Rabellotti, 1997).

The remainder of the paper is organized as follows. The next section describes the cluster and the survey. Section three provides the model and section four describes the operationalization of the variables. Section five discusses estimation issues and the econometric results. The last section concludes.

2. Description of the cluster and the survey

2.1. The Mercato footwear cluster: some background

The Mercato footwear cluster is a spontaneously grown agglomeration of small enterprises. Its name reflects its location. Mercato is the largest open air market in East Africa located in the city centre of Addis Ababa. The footwear cluster is believed to comprise above 1500 shoe makers. This cluster is also home of many other related businesses and complementary activities that include buyers, suppliers of various inputs (soles, leather, shoe accessories), and service providers (repair, machinery rent etc.). According to our survey, the producers obtain nearly all raw materials needed for the shoe making and services such as machinery and equipment maintenance, design, and labor supply from the cluster. The majority of firms also sell their products through wholesalers that are mainly located in the cluster and the vicinity.

This cluster has been functioning for decades and passed through difficult times. The socialist ideology and associated command economy that persisted for about two decades (1975-91) in the country was hostile to private investment and entrepreneurship. The cluster and the sector at large were stifled as a result. With the change of government in 1991 the country undertook extensive policy reforms to transfer the economy into a market oriented one. It also adopted a

structural adjustment program that includes domestic market deregulation and trade opening. Some of these reforms might help for the revival of the cluster and the private sector at large. However, the domestic market was flooded with imports particularly Chinese-made shoes following the trade opening. The imported Chinese shoes were less durable but had better finishing, were more fashionable and cheaper than the products produced in the cluster and elsewhere in the country. Throughout the 1990s, the domestic footwear industry was hit hard. As a result many firms could not compete and were forced to close/change or downsize their business.

The government export promotion strategy that was adopted in 1998 and consequent industrial strategy considers the leather industry as a priority sector. This is partly justified based on the fact that Ethiopia has the largest livestock production in Africa and the 10th largest in the world, which gives the country a comparative advantage in the raw materials needed for the leather sector. The strategy emphasizes the need to upgrade exports from unprocessed toward fully processed leather and final products such as footwear, bags, jackets etc. The main focus of the export promotion, however, has been the large footwear firms. The Mercato small firms footwear cluster did also not benefit from the government Micro and Small Enterprises (MSE) promotion initiatives mainly because it operates out of the radar of officials.

Despite the absence of support from the government, the Mercato small shoe cluster has made a remarkable recovery in the early 2000s at a time when the large firms continue to struggle for survival and lobby for government support. Although there is no official record on the number of firms in the cluster, recent studies have shown the increasing expansion of this cluster. Prior to 2000 the number of firms in the cluster was estimated to be around 500 (van der Loop, 2003). This number increased substantially following the recovery from the severe import competition and reached about 1000 by 2005 (Sonobe et al., 2006) and is currently above 1500.

Sonobe et al. (2006) argue that the resurgence of the Mercato footwear cluster is mainly the outcome of persistence endogenous upgrading efforts by the cluster firms that received, however, no protection or any other special public support. The current study substantiated the fact that the cluster has managed to recover as a result of continuous innovation and learning efforts mainly imitating foreign designs (including Chinese) and using improved quality of raw materials. When respondents in our sample asked if the Chinese imports was

ever a threat for their business 92 per cent said "yes". They were then asked how they reacted to the Chinese import competition. About 63 per cent of the firms reported that they used better quality of raw materials, 24 per cent improved product design and other 20 per cent changed or downsized their business.[1] In addition to the improvement of quality and design of products, consumers' growing perception that Chinese products are less durable might also have contributed to the revival of the cluster. Consequently, the severity of the competition had eased from time to time. In 2008 only 12 per cent of the firms reported that competition from Chinese imports is still critical in contrast to five years prior to the survey when about 41 per cent identified the competition from Chinese products was critical.

A similar recovery from intense import competition has been documented in footwear clusters in other developing countries such as Agra (India), Guadalajara (Mexico), and Sinos Valley (Brazil) through increasing efficiency and upgrading capabilities. However, unlike the major footwear clusters elsewhere, the Mercato cluster is largely constituted by firms that operate informally and that have not yet gone into the export market. It remains solely producing for the domestic market although the cluster has been booming and its share is believed to have increased in the domestic market. Certain initiatives have been underway to organize these firms and link them to the international market by one prominent businessman and to provide support from the government since 2007. Unfortunately, there was not much progress in this regard at least up to the survey period (end of 2008).

2.2. Data and some characteristics of the sample firms and their owners

This study is based on firm level data for 153 randomly selected shoemaking firms operating in the Mercato cluster at the end of 2008. [2] It was collected through face to face interview with owners/managers of the firms based on a structured questionnaire. The survey instrument covers a wide range of issues such as enterprise history; owner/manager profile; production, sales and costs; source and mechanisms of competition, and marketing strategies. It also includes a particular set of questions related to innovation activities, networks and capabilities of the firms.

[1] Note that since multiple answers was allowed the percents do not add up to 100.
[2] This second survey is a joint project of National Graduate Institute for Policy Studies (GRIPS) and the Ethiopian Development research institute (EDRI). The first author of this study coordinated the second round of the survey.

Technically this survey was a second round of a survey that was conducted in 2005. The first survey was used as a basis for the sampling framework of the current survey. We aimed at constructing panel data, thus, making sure all surviving firms in the early survey were included in the second round. We were able to find only 64 firms out of 90 firms interviewed in the first round, mainly due to exit. The remaining (i.e. 89) firms were randomly selected based on a list of firms operating in the cluster.[3] Unfortunately, the first round survey was not only smaller in terms of sample size but had also a limited objective. It did not include questions related to innovation and network studies. This study is thus unable to use the panel structure and relies only on the second round survey – i.e. a cross-sectional data. The rest of this sub-section discusses some characteristics of the sample of firms/owners. Sub-sections 2.3 and 2.4, on the other hand, give some description on innovation and networking in the cluster.

Table 1 gives the size and age distribution of the sample firms. The distribution of employment shows that the cluster consists largely of micro enterprises. For example in the survey year about 76 per cent of firms employ 10 or less people (including the owner) of which 36 per cent employ 5 or less people and 41 per cent between 6 and 10 people. The cluster also comprises some medium size firms (20 and more employees), which is not usual in such a cluster that largely consists of informally operating small firms. Most of the firms are relatively younger, i.e. 34.6 per cent are five and fewer years old and 42.5 per cent are between 6 and 10 years old.

The majority of the firms (90 per cent) produce gentlemen's shoes, out of which 50 per cent produce only gentlemen's shoes, while 29 per cent and 10 per cent mix children's and ladies' shoes respectively. On the other hand, 10.5 per cent firms exclusively produce ladies' shoes. Most of the firms are working informally without any registration or license. Of all the firms in the sample only 23 per cent are registered and 12.4 per cent have a working license. The respondents were asked why their business is not formally registered. About one -third of them responded that there are no good reasons to register because business is too small. Others cited no benefit from registration (11.7%), taxes too high if registered (5.8%), and too many formalities if registered (3.27%).

[3] We obtained an incomplete list of operating firms in the cluster from two local associations. We complemented this list by dispatching enumerators and contacting local knowledgeable people and industry specialists.

Table 1 also reports some characteristics of the entrepreneurs. As found in many other developing country clusters (e.g. Agra shoe cluster in India) the Mercato shoe cluster is characterized by homogeneous social background. The majority of the entrepreneurs come from one ethnic group – known as Guraghe – that constitutes about 87 per cent of the total number of entrepreneurs in our sample. Other early studies have also shown the dominance of this ethnic group in the cluster (for example van der Loop, 2003; Sonobe et al. 2006). The Guraghe constitute no more than 3 per cent of the Ethiopian population but they are known for their active involvement even in other businesses in the country. For example, Mengistae (2001) found that nearly a third of manufacturing enterprises in Addis Ababa region, where the majority of industries in the country are located, are owned by Guraghe entrepreneurs.

Apart from ethnic homogeneity there is also a strong family network within the cluster. A second-generation entrepreneurs (parents with shoe making experience) account for about 21 per cent of the entrepreneurs. Above half (55%) have also reported that they have siblings in the shoe making business in the cluster that includes producers, suppliers, buyers, or other related activities. The demographic and occupational background of the entrepreneurs is also somewhat homogenous. The entrepreneurs are dominantly male (99%). Almost all the entrepreneurs learn shoe making skills on the job training, of which 68 per cent learned it as a worker in a small shoe making firm and the rest in family owned enterprises. Most of the entrepreneurs have a low level of formal education, i.e. 55.7 per cent completed primary education or junior high school, and only 34.6 per cent senior high school. Few entrepreneurs (8%) had vocational and technical training or college education.

2.3. Competition and innovation in the cluster

Until recently, the main source of competition to the cluster was shoes imports from China. However, the severity of the import competition eased through time and currently the main source of competition comes from within the cluster itself. From the sample of firms about 75 per cent indicated competition from within the cluster as major or critically important, whereas only 12 per cent reported Chinese import as still critical. Consistent with the characteristics of dynamic clusters, the main method of competition in this cluster is through innovation and quality improvement. When firms were asked if they had made any important improvement or change to their business within three years prior to the survey year interestingly the majority (83%) responded positively. About 68 per cent of them indicated that the major driving force for the improvement they made was higher local competition. On

other hand, 17 per cent and 5 percent referred emergence of new demand and import competition respectively as the major reasons for the changes made.

In understanding the type and the extent of innovation that takes place in this small firms cluster the firms that made important improvement or changed their business in the last three years were requested to indicate their first three major changes. A number of innovation activities were reported that include quality improvement, better design, machinery investment, increasing variety of product, and workers skill improvement. Certain types of innovation came out as dominant activities in the cluster (see Table 2). Quality improvement and introduction of better design were carried out by about 70.6 per cent and 68 per cent of firms respectively. Machinery investment and increasing the variety of products were also reported each by about a quarter of the firms to have taken place.

Quality improvement might be a result of other innovation activities, such as improved raw material, better design and finishing, improved workers skill etc. It turns out that it mainly reflects the increasing use of higher quality of raw materials. This is clearer when looking at the firms' ranking on their perception of the source of competitiveness.[4] Leather and soles are the two main inputs in the shoe making accounting on average for respectively 54 per cent and 22 per cent of total cost of raw materials and intermediate goods. Locally produced leather and soles account for about 96 per cent of total inputs of leather and soles. The firms acknowledge that the quality of domestic produced leather has improved recently, thus, increased availability of improved quality of supply of the inputs might have contributed to the quality changes claimed by the producers.

In the footwear industry **design** is the source of differentiation. As indicated above it is one of the major dimensions of innovation in our case study, 68 per cent reporting to have introduced better design in the sample period. In the survey year, an average firm was producing about 4 types of designs at a time. There was, however, a wide variation in the number of designs between the firms. About two-third of the firms were producing up to 5 designs, while another 28 per cent produced 6 to 9 designs and 6 per cent above 10 designs. We have also found a high frequency of change in designs. For example, above two-third of the firms changed their designs fully within a period of three years. Firms were also asked major ways in which they acquired new designs. The major sources of designs identified by

[4] When firms were asked to rank how important a number of factors were in determining their business competitiveness they emphasized the use of quality materials (71%), better design (54%), and increasing number of designs (51%).

large number of firms include freelancer designers (60%), copying from imported shoes (60%), copying from catalogues (54%), and clients (18%). Note that the percentages do not add up to 100 because multiple answers are possible. This shows that the main form of introducing new designs is imitation. Obviously small firms are not expected to have a special department of designers.[5]

Investment in **machinery and equipment** was another significant innovation activity according to the responses. Even if shoe manufacturing requires a number of machines most of the small firms in our sample tend to be undercapitalized. The types of machines that are possessed by a large number of firms are: stitching (by 90.8% firms), roughing (by 62.1% firms), and compressor and sprayer (by 33.3% firms). Other machines such as splitting, skiving, pressing, lasting, and heating were found in few firms (only between 13% - 22% of the sample), which implies that most of the firms obtain such services from the cluster through rent or used hand tools. There is, however, a gradual mechanization process in the cluster. Most of the machines are the result of recent investments. Above half of all the existing machines and equipments were purchased in the last three years. The majority of firms purchased second-hand machinery and equipments. For example, about 74.8 per cent of stitching, 68 per cent of roughing, and 64 per cent of compressor & sprayer, which are widely owned in the cluster, were second-hand. [6]

2.4. Networks and knowledge linkages in the cluster

The cluster has very weak external linkages with regard to knowledge interaction. Given the informal nature of the cluster no public knowledge centre (e.g. R&D centre or training institution) has formal relations with the cluster. The cluster does not seem to benefit much from the Leather and Leather Products Training Institution (LLPTI) that was established by the government in the late 1990s in an effort to enhance the human capital for the sector. We found only 9 employees in 8 firms that received training in LLPTI. Neither other parts of the government nor the NGOs have any significant contribution to the knowledge in the cluster. From our sample only 13 entrepreneurs received short term training after establishing their business from government or through NGO- sponsored training programs. None of them sent workers for outside training. The cluster also receives no other services such as information

[5] The table containing the number and source of designs is not reported here to save space.
[6] The table containing the type, source and age of the machinery and equipment is not reported here to save space.

on business trends, contacts on product and input markets, on mechanism of joint marketing and business promotion from government or anybody else.

Unlike the developed clusters elsewhere, there does not seem to be much subcontracting between producers at different stages of the product in this cluster. It is not connected to any international markets and buyers. The dominant forms of business networks are relations with buyers and suppliers within the cluster. Table 3 reports the distribution, length and also nature of this relation. Although the majority of firms reported having permanent relations with one or more suppliers and clients, the intensity of relations differs by firm. For example, about 24 per cent firms have permanent relation with 1 to 3 suppliers and about 31 per cent with 4 to 6 suppliers. Another 28 per cent have permanent relations with 7 and more suppliers. We find similar differences when looking at the distribution of number of clients with permanent relation. The majority (95%) of the respondents reported that their relation with the main supplier/client is built up on long-term business interactions. More than half of the firms reported that the length of their relation with their main suppliers and clients is at least 3 years and three-quarter have at least a one-year long relationship.

The business networks are not only goods-centered linkages but also the major channels through which marketing and technical knowledge flows in the cluster. According to our survey results, about 86 per cent of the firms reported to have mainly relied on clients as a source of marketing knowledge. As indicated in the previous sub-section clients are also an important source of new designs. In an effort to further explore the knowledge source and linkages in the cluster respondents were provided a list of possible types of collaborations and asked to indicate for each the extent of collaborations (in a five-point Likert scale ranging from “not at all’ to “very significantly”) with clients, suppliers and other producers in the cluster. The list includes information and experience exchange, quality improvement, setting product specification, design sharing, workers training, machine and order sharing. Moreover, they were asked the number of partners for each type of collaboration and partner.

Table 4 summarizes the extent of collaboration and the number of partners. The responses from this bunch of questions show that the majority of firms are involved in various types of co-operations within the cluster. However, the intensities of these collaborations differ in three important aspects. First, the types of co-operations that are widely practiced are mainly

information and experience exchange and quality improvement.[7] For example, about 60 per cent and 30 per cent of the firms reported that they cooperate significantly or very significantly with their buyers and suppliers respectively on information and experience exchange. The most important forms of collaboration among producers are also information and experience exchange in which 23.5 per cent firms have significant or very significant collaboration. In contrast, there exists relatively less collaboration in terms of design sharing, machine sharing, order sharing, or joint worker training. Second, we found wide differences in the extent of interaction between suppliers, clients, and other producers. There exists a relatively strong vertical interaction with suppliers and clients in most types of collaboration, although the forward interactions (i.e. with buyers) are more intensive than the backward interactions (with suppliers). In contrast, the collaborations with other producers are less dense. There is a lack of collaboration among producers particularly in terms of design, order and machine sharing and workers training, whereby above 90 per cent responded "not at all".

Thirdly and maybe more importantly, we find a wide variation between firms in their extent of connectedness into the existing networks in the cluster. Some are well connected while others less or loosely connected. We use the number of partners to whom each firm has a relation on information and experience exchange as an indicator of connectedness into networks.[8] The distribution of this variable and test of skewedness is reported in Table 4. We find a skewed distribution in the number of partners which ranges from zero (5% firms) up to 10 and more partners (30% firms). The distribution is more skewed when looking separately at the distribution of number of buyers, suppliers and other producers with whom the firm has collaboration. We formally tested the normality of the distribution of the number of partners using the Shapiro-Wilk normality test. The normality assumption is rejected for all the measures of connectedness separately and in the aggregate.[9]

The wide variation between firms in their connectedness in each of the networks gives some evidence in contrast to the claim that the business interactions are evenly distributed (Giuliani, 2005). This might be due to the fact that business networks are also selective

[7] The distributions of these two types of cooperation look very similar and we suspect the latter is nested in the former. The discussion that follows will, therefore, focus on information and experience exchange cooperation.
[8] The other measure of connectedness, extent of collaboration, was also explored and gave similarly a skewed distribution.
[9] The Shapiro-Wilk test relies on the ratio of the estimator of the variance to the usual corrected sum of squares estimator of the variance. The statistic should be positive and less than or equal to one. A statistic W statistically different from one implies divergence from normality. We found W statistics lower than one for all indicators (between 0.89 and 0.92) and p-values of zero, leading us to reject the null hypothesis that the data are normally distributed.

similar to knowledge networks. We have shown above that the relations with main clients/suppliers in the cluster are the result of a long-term business interactions and trust which lends some support for selectiveness of business networks.

3. The model

An increasing number of studies highlight that firms in a cluster are heterogeneous in various aspects and perform differently (e.g. Lazerson and Lorenzoni, 1999; Rabellotti and Schmitz, 1999; Giuliani, 2006; Boschma and Wal, 2007). One source of heterogeneity among firms in a cluster that is cited to affect innovation performance is the difference in absorptive capacity. The presence of relevant skills and knowledge that enables to do new things, i.e. technological capability (Lall, 1992) or absorptive capacity (Cohen and Levinthal, 1990), is very important not only to generate new knowledge but also to adopt an externally developed knowledge. However, firms are heterogeneous in their knowledge base. Technological knowledge is not shared equally among firms, nor is it easily imitated or transferred across firms. This is due to the fact that technologies are partly tacit and accumulate in the structure of firms, embodied in routines and human resources (Nelson and Winter, 1982).

The importance of internal absorptive capacity, sometimes termed as human capital of the firm in development economics, on firm innovation performance is well established fact in the innovation literature (Nelson and Winter, 1982; Dosi, 1988; Cohen and Levinthal, 1990). Unfortunately, this has been overlooked in the cluster literature due to the focus on meso-level analysis and the view that firms in a cluster are homogenous, i.e. share the same values, background and understanding of technical and commercial problems (Maskell and Malmberg, 1999; Boschma and Wal, 2007).

Another source of heterogeneity is that firms are not equally embedded into existing networks, inside or outside the cluster. The literature so far has focused on extra-cluster knowledge linkages and power asymmetry among firms in the cluster. Technological gatekeepers may act as ‘bridging enterprises’ linking the cluster with the outside world. While the leading firms share and exchange knowledge with only a few selected local partners, other district firms lack the competence for effective knowledge transfer. Thus, knowledge will not spread equally among all district firms. Giuliani and Bell (2005) argue that firms with higher absorptive capacities in a cluster are more likely to establish linkages with external sources of knowledge. The propensity of firms to establish knowledge linkages

with other firms is associated with the degree of similarity/dissimilarity in their knowledge bases.

A number of studies from Italian industrial district provide evidence of emergence of powerful leading firms acting as gatekeepers of knowledge in the cluster and as a result uneven embeddedness into networks (e.g. Morrison 2004, Owen-Smith and Powell, 2004; Boschma and Wal, 2007). Giuliani and Bell (2005) have observed similarly the existence of technological gatekeepers that contribute actively to the acquisition, creation and diffusion of knowledge in Chilean wine cluster. Giuliani (2006) and Boschma and Wal (2007) empirically tested the impact of heterogeneity in the embeddedness in networks and in absorptive capacity on innovation performance in clusters based on micro-level data. Both show that the factors (i.e. absorptive capacity and extent of embeddedness in networks) that predict differential innovation performance among non-clustered firms also cause cluster firms to perform differently.

Having clarified embeddedness into business networks and internal absorptive capacity as potential sources of differential innovation performance among cluster firms, we now present the benchmark model:

$$INV_i = \alpha_0 + \alpha_1 N + \alpha_2 C + \alpha_3 X + \varepsilon_i \quad (1)$$

where INV denotes innovation, N networks, C internal capacity, and X control variables including other firm and entrepreneurial attributes.

4. Variables and operationalizations

The definition of innovation, internal capability and networks differ depending on the context of the study, for example, small versus large firms, those operate in developed versus developing countries, and formal versus informal ones. Moreover, the literature consists of a multi-dimensional construct of innovation, absorptive capacity and networks with differing interpretation. We would, therefore, like to discuss below the measurement of each of the variables in the context of informally operating small firms in a cluster in a developing country.

4.1. Measuring innovation

At the firm level there are three major sources of innovation: imitative, acquisitive (licensing, acquisition or merger) and incubative (developing own innovations internally). Innovation in

a small enterprise in the developing countries context is largely an adoption of a product, process or method that has already been developed elsewhere (Van Dijk, 2002). In the context of mostly imitative practices of small firms in our case study we adopt the definition of innovation as "the process by which firms master and implement the design and production of goods and services that are new to them, irrespective of whether they are new to their competitors, their countries or the world" (Mytelka, 2000). According to this broad definition, innovation activity might include introducing new products/services, new design, and improving quality of products/services, installing new equipment, changing sales methods, and improving working conditions.

The innovation literature provides various categorizations of innovation, for example, process, product, organizational and marketing innovations; and output versus input innovations. Our survey contains a number of innovation-related questions. Respondents were first asked if they made any important improvement or change to their business within three years prior to the survey year. As shown in the previous section (Table 2) the overwhelming number of firms responded "yes". Different innovation activities were reported to have taken place in the cluster firms that include quality improvement, better design, machinery investment, increasing variety of product, and workers skill improvement. These innovation activities could be categorized into the standard classification namely product (better design, increasing product variety), process (quality improvement, M&E investment), and organizational (managerial and workers skill).

However, we observed a lot of overlaps in the responses for example between quality improvement and better design, and increase variety of products and better design. How novel is the design introduced to be considered as a product innovation and how does it differ from increasing the variety of products? Is quality improvement the result of improved material, better design, or improved skill? Our data do not identify such details. Given the incremental nature of the innovation activities in the small firms cluster we are also unable to quantify the innovation activities in terms of output or input, for example the proportion of sales for new products introduced and innovation related expenses. Moreover, there are complementarities between the innovation activities. The majority of firms (82 per cent) have been involved in more than one type of innovation activities of which 72 per cent made both product and process innovation.

We, therefore, preferred to define innovation in terms of the intensity of innovation activities i.e. how many types of innovation activities the firm undertook in the three years prior to the survey period, and constructed an index of innovation. The *innovation intensity* is a categorical variable measuring if the firm is involved in multiple innovative activities which include machinery investment, better design, increasing variety of products, increase quality of products, and skill improvement. The variable is named *INV*, and it is assigned the values 0, 1, and 2 (0 = no innovation, 1 = two innovations, and 2 = three innovations).[10]

As an alternative, we have also estimated equation specification that distinguishes between product and process innovation despite our concern of complementarity and overlapping definition between these types of innovations. Both the product and process innovation variables are dummies, the first capturing whether the firm increased its product variety or introduced better design, while the second refers to increasing the quality of the product or machinery investment. Moreover, we use different categorization of innovation classifying firms between innovators and non-innovators, and also less innovators and high innovators.

4.2. Measuring networks

Different definitions of networks have been used in the empirical studies of cluster networks. Some have distinguished between internal and external networks (e.g. Boschma and Wal, 2007) and others define it in terms of knowledge and business networks (e.g Giuliani, 2006). The emphasis on explicit knowledge networks and extra-cluster linkages is not tenable in our case. This is because firms tend to have less extra-cluster interactions and most of them obtain information and innovation ideas largely from informal interactions with their business partners mainly located in the cluster. In such a cluster knowledge and production systems overlap substantially. With this context, we focus on business networks with buyers, suppliers and other producers mainly from within the cluster.

As shown in the descriptive part, the dominant types of interactions with various actors in the cluster are information and experience exchange, which is the major mechanism for learning and innovation particularly in clusters of small firms. We, therefore, define network embeddedness as the sum of the number of buyers, suppliers and other producers with whom the firm has collaboration on information and experience exchange, hereafter denoted as

[10] As shown in table 3, there were only two firms with the category of one innovation activity. Two observations are too few to be in one category. One way to deal with this problem is to put the two observations in the lower or higher category. Their inclusion in the lower or next higher category does not change the results. However, due to the arbitrariness of the classification we decided to drop them from the main estimations.

num_part. The belief is that having access to more and various networks help firms to broaden their knowledge base (Powell and Grodal, 2005), thus, be able to engage in more innovation activity (Colman, 1988).

Many studies of informal relationship stress the significance of trust (e.g. Tsai and Ghoshal, 1998; Uzzi, 1997). Dense networks are characterized by strong compliance to social norms and high level of mutual trust. A high level of trust among organizations facilitates the exchange of highly confidential information by diminishing the risk of opportunism. Economic actors are more likely to focus on co-operating with those partners with whom they maintain a stronger interpersonal trust relationship (Dakhli and Clercq, 2004). Trust and interpersonal relationships are often argued to play a pivotal role when market institutions are weak or absent, which is apparent in clusters of informal firms as is the case in this study. Rousseau et al. (1998) distinguish between three forms of trust: deterrence-based, calculus or rational-based, and relational-based. In this study we focus on relational trust that arises from repeated interactions or emotional attachments. These are sometimes referred to acquired and inherited trust to indicate trust built in long-term relationship and trust based on family ties respectively.

In this context we have introduced into the model two more network related variables indicating the length of the relationship with business partners (in this case suppliers and buyers) and social networks (based on family ties) in the cluster. The first captures acquired trust from long-term relationship and is measured by the average length of the relationship the firm has with its permanent buyers and suppliers (*leng_rel*). As discussed in the descriptive part above half of the firms have a 3-year or longer relationship with their main suppliers and clients and about 95 per cent indicated this relationship was built in long-term business interactions, but not based on any family ties or on being born in the same locality. The second variable is a dummy variable (*sibl*) which equals one if the owner of the firm has siblings in the shoe making business in the cluster and zero otherwise. It approximates inherited trust based on family ties. In our data above half (54 per cent) of the owners are found to have siblings in the shoe making business as producers, suppliers, or buyers are mostly located in the same cluster.

4.3. Measuring absorptive capacity

Knowledge is embedded in individuals as specific skills or in fixed capital which are used in the production process (Maskel and Malmberg, 1999). In-house R&D activities and highly educated personnel are often perceived as the most effective ways to absorb external knowledge, thus, are often used as a measure of absorptive capacity (e.g. Oerlemans and Meeus, 2005).[11] However, small firms in developing countries, such as the Mercato cluster in our case, have neither separate R&D department nor formally trained technicians/scientists. Skills are usually developed through job training and practical experience. That means the longer they work the more skill they obtain. In our data the majority of workers has no formal technical trainings, but acquires their skills on the job. In this context we take the average tenure (in months) of the workers in the firm (*wrk_tnr*) as the measure of workers' skills. The weakness of this variable is that it does not capture experience of the worker acquired elsewhere.

Innovation in MSEs is often defined in the context of entrepreneurial dynamism. The human capital of the entrepreneur is, therefore, used as indicator of firm absorptive capacity. This is partly justified on the ground that in small businesses decision making is concentrated in the hands of the owner manager (Dyer and Handler, 1994). Several studies have reported positive association between owner's education and innovativeness (e.g. Khan and Manopichetwattana, 1989; Hausman, 2005; Robson, Haugh, and Obeng 2008; Gebreeyesus, 2010). We introduce owner's education to capture entrepreneurial competency. Owner's education (*owner_edc*) is a dummy variable that equals one if the owner completed high school education or higher education and zero otherwise. As discussed in the descriptive part most of the owners have relatively lower education and very few have technical training.

The length of work experience of the owner might also be important for innovation given the low background of education for many of the owners. Owner's experience constitutes prior and post-entry experience. In our case only two owners reported that they inherited the business, while the other owners started from scratch. We, thus, rely on the post-entry

[11] Giuliani (2006) and Boschma and Wal (2007) employed a Principal Component Analysis to construct a single variable of firm absorptive capacity from various indicators. We follow their method and perform PCA on the variables indicated above and other additional variables but we find no strong correlation between them and are unable to generate a single variable that explains a large part of the variance. That means the indicators (e.g. workers skill, entrepreneurial education and experience) in our data might be capturing different dimensions of absorptive capacity.

experience of the entrepreneur and introduce firm age (*firm_age*) into the model.[12] A number of studies tested the relation between innovation and firm age. The empirical evidence in Africa so far is mixed. Wignaraja (2002) and Deraniyagaa and Semboja (1999) found supporting evidence of a positive relation between firm age and innovation. On the other hand, Robson et al. (2008) found no significant effect between firm age and innovation, while Gebreeyesus (2010) reports a negative relation.

4.4. Other control variables

In the model we control for firm size. Firm size is found to affect innovation capacity in several previous empirical studies, although the results are so far inconclusive (Nooteboom, 1994). A positive association between size and innovation is justified on the ground that size might capture resource availability. Current size might be endogenous to the model given that our dependent variable is innovation intensity in the last three-years. We, therefore, rely on size of the firm 3 years ago, i.e. 2005. When taking 2005 we find missing data mainly for entrants after 2005. For these firms we take the earliest possible year (or entry) size. We define size of the firm by the number of employees including the owner and constructed three size categories (1-4, 5-10 and above 10) of which the small size class is the reference category. We have also controlled for ethnicity of the owner. Ethnicity of the owner is a dummy representing, Guraghe, the dominant ethnic group in the cluster, and is denoted by *ethn_Grg*. The definition and some summary statistics of the variables included in the model are given in Table 5.

5. Estimation and results

Based on the above discussions, we re-formulate the econometric model in equation (1) as follows. The dependent variable (*INV*) in equation (2) is an ordered categorical variable which ranges from 0 to 2, (0 = no innovation, 1 = two innovations, and 2 = three or more innovations). We assume that there is a latent variable INV_i^* given by the following expression;

[12] In an earlier version of this paper we defined owner's experience as the sum of number of years as a worker or trainee before founding the firm plus the age of the firm. We found negative coefficient but marginally significant. We then estimated another specification with a breakdown of these two variables into pre- and post-startup experience. We find a low and insignificant coefficient for the pre-startup experience, while firm age continues to give larger negative coefficient and in fact statistically more significant.

$$INV_i^* = \alpha_0 + \alpha_1 \ln(num\_part)_i + \alpha_2 \ln(leng\_rel)_i + \alpha_3\, own\_edc_i + \alpha_4 \ln(firm\_age)_i + \alpha_5 \ln(wrk\_tnr)_i + \alpha_6\, ethn\_Grg_i + \alpha_7\, sibl_i + \alpha_8\, emp\_catg2_i + \alpha_9\, emp\_catg3_i + \epsilon_i \quad (2)$$

We also assume that the ε_i are iid random variables that follow a normal distribution, i.e. $\varepsilon_i \sim N(0, 1)$. The link between the observed and the latent variable is given by

$$P(INV_i = 0|Z_i) = \Phi(\mu_1 - Z_i\gamma)$$

$$P(INV_i = 1|Z_i) = \Phi(\mu_2 - Z_i\gamma) - \Phi(\mu_1 - Z_i\gamma)$$

$$P(INV_i = 2|Z_i) = 1 - \Phi(\mu_2 - Z_i\gamma) \quad (3)$$

where Φ is a cumulative normal distribution function (c.d.f.) of ε_i, $\gamma = [\alpha_1, \alpha_2, \ldots \alpha_9]$ are the coefficients of the explanatory variables Z_i that appear in equation (2), and μ_1 and μ_2 are the unknown threshold parameters that differentiate the categories. The model is estimated by maximum likelihood.

A key assumption in this setup is that the set of γ coefficients are equal for each equation (i.e., across response categories). We tested the assumption of parallel regression by comparing the estimates of the ordered probit with those of the generalized ordered probit, where not just the intercept but also the set of γ coefficients vary by category of the dependent variable. The likelihood ratio (LR) test with a null hypothesis that the coefficients are equal across categories yields p-value equals 0.197 suggesting that the parallel regression assumption is not violated (see Table 6).

Another statistical concern that needs to be pointed out at this juncture is that network, the main explanatory variable of interest, might be endogenous to the model, i.e. correlated with the error term. Theoretically, endogeneity might arise from measurement error, omitted variables correlated with the independent variable of interest, or due to simultaneity. We formally tested if the network variable (*num_part*) is endogenous in the model following the two-step approach suggested by Rivers and Vuong (1988) for discrete responses with continuous endogenous variable. In the first stage we run OLS regression of number of partners on a set of exogenous variables including a dummy capturing if the firm makes negotiations to set price with its customers (*price_neg*), the share of sales directed to traders from the region (*reg_share*), and the size of the firm measured by the number of pairs of

shoes produced before the sample period, i.e. 2005 *ln*(*pairs_sh*), hereafter network equation.[13] We then estimated the innovation equation including the residual from the first stage regression ($\hat{v}$) into the ordered probit model. The t-test of the residual is significant at 5 per cent level implying that the null hypothesis that network is exogenous to the model is rejected.

In the presence of endogeneity the standard estimation methods produce biased and inconsistent parameter estimates. The two-stage least square (2SLS) is one way of correcting the endogeneity problem. The advantage of 2SLS depends on having good instruments, i.e. strongly correlated with the potentially endogenous variable and genuinely exogenous to the model (uncorrelated with the error term in the structural equation). Even if testable the choice of instruments is challenging. The 2SLS might also lead to a loss of precision due to two stage estimation.

A structural equation model whereby both the innovation and the network equations are jointly estimated by Maximum Likelihood (ML) is another method addressing the endogeneity problem. The ML estimator is the most efficient if the model specification is correct. We assume a recursive structure whereby causation only runs from network to innovation but there is no feedback from innovation to network.[14] The expression for the latent variable in equation (2) is replaced by;

$$INV_i^* = \beta_0 + \beta_1 M_i + \beta N_i + u_1$$

$$N_i = \theta_0 + \theta_1 W_i + u_2 \qquad (4)$$

where M denotes a subset of the independent variables Z in the innovation equation excluding network (N), and W is a set of exogenous variables in the reduced form equation for network.

Table 6 gives the estimation results of the innovation performance equation estimated by ordered probit (here after, OPROBIT). The first column provides the benchmark (equation 2) estimation results. The second column controls for endogeneity by the way of estimating a

[13] These variables are believed to be positively associated with network size. For example, higher sales share to regions widens the firms' network. Firms with large network are more likely to make price negotiations with their customers in contrast to those less established ones. And obviously, larger firms are more likely to have more connections. There are some missing observations in the variable measuring size (pairs of shoes produced) due to late entry of some firms. For these firms we take the number of pairs of shoes produced upon entry year.
[14] This is not merely an assumption. We have also run a regression of network on innovation and found no significant effect in this direction.

simultaneous equation with a recursive structure based on equation (4).[15] We have also estimated 2SLS model whereby a predicted value of network equation is substituted in the innovation equation (see Table A1 in the appendix). All these models seem to give qualitatively similar results. The measure of network (*Num_part*), length of relationship (*leng_rel*), and owner education (*owner_edc*) are positive and significant in all estimations. They all yield a negative and significant coefficient for firm age (firm_age). They also give similar result for workers tenure (positive) and family network (negative) but both insignificant. Ethnic Gurghe dummy is positive but only significant in the first column that does not take account of endogeneity. The main difference between these estimation results is that the magnitude of the network coefficient becomes larger (almost double) when endogeneity of the network is controlled for. The reason is probably due to some omitted variables that affect innovation and the network size in the opposite direction, as reflected by the negative correlation between the error terms in the two equations. As a consequence network when treated as exogenous is downward biased because it also captures the negative effect of the omitted variables.

Next we discuss the results in detail based on our preferred model (column II), i.e. the one that controls for endogeneity through joint estimation with network. The ordered probit models, however, produce coefficients that are not easily interpretable as such. It is therefore useful to compute marginal effects of the explanatory variables. The average marginal effects of each of the explanatory variables for each category of innovation performance are reported in the last three columns of Table 6. They are calculated based on the estimation of the model that controlled endogeneity and reported under column II. The marginal effects from the order probit model captures the effect of a unitary change for a continuous variable or a change from 0 to 1 for a binary variable on the probability of observing a specific categorical outcome of the dependent variable. [16]

The main variable of interest, network (*num_part*) as measured by the number of partners with whom the firm exchanges information and experience, is positive and highly significant. This gives evidence that firms that collaborate with more partners on information and experience exchange are more likely to engage in more innovative activities. According to the

[15] In estimating this simultaneous equation we used a program called cmp (Conditional Mixed Process) in stata developed by Roodman (2009).

[16] Some of the variables with log format in our estimation were constructed as ln(x+1), where x the main variable of interest, to avoid missing values from observations with 0 value when taking logs. The marginal effects do not take this into account. Hence, they are slightly overestimated (by about 9 to 12 per cent depending on the variable).

marginal effect estimates, doubling the number of partners with whom the firm interacts on information and experience exchange, all other things remaining equal, raises the probability of being in the high innovative group by 39 per cent and lowers the probability of being in the middle innovation group and the no innovation group by about 12.1 and 27 per cent respectively.

In the network literature, there is an increasing concern that redundant network might act as an obstacle to innovation (e.g. Burt, 1992), thus, innovation performance and networks might be related non-linearly. In light of this we introduced a quadratic term of the network variable into the model. The network variable at the first level continues to yield a positive and significant coefficient while the quadratic term is negative but not statistically significant (see, column III in Table 6). The relative fitness of the two nested models was also compared using a likelihood ration (LR) test. The null that the linear specification is the true model cannot be rejected. This suggests that there is no evidence of curve-linear relationship between innovation and networks in our data unlike to recent finding by Rooks, Szirmai, and Sserwanga (2009) in Uganda based on data from a survey of non-clustered entrepreneurial households. This might be due to the fact that our measure of network is more refined, i.e. it measures not simply the size of the business network but specifically the number of business partners with whom the firm exchanges information and experience.

The coefficient of the length of the relationship (*leng_rel*) is positive and significant suggesting that not only the size of network but also trust, which is acquired through long-term relationship, is advantageous for innovation. Increasing the average length of the relationship with permanent partners by 100 per cent, all other things remain equal, increases the probability of being in the high innovation group by about 11 per cent and reduces being in the middle and no innovation groups by about 3.3 and 7.6 per cent respectively. In contrast, the number of siblings in the cluster capturing family network or inherited trust is statistically insignificant. This is consistent with our observation in the descriptive part that firms' cooperation is mainly based on long-term business interaction but not on any kind of family relations or on being born in the same locality. The non-significance of family network implies that, unlike business interactions, family relations might carry less information (Fafchamps and Minten, 2002) or even redundant.

Among the variables capturing firm absorptive capacity only owner's education (*owner_edc*) appears to have a positive and strong impact on firm innovativeness. Having the owner

completed high school or higher education, other variables remaining constant, raises the probability of being in the high innovation group by 16 per cent and reduces the probability of being in the middle and lowest group by 5.1 per cent and 11.5 per cent respectively. The positive impact of owner education on innovation is consistent with previous studies (e.g. Hausman, 2005; Robson, Haugh, and Obeng 2008; and Gebreeyesus, 2010). The average tenure of workers (wrk_tnr), on the other hand, yields positive coefficient but significant in none of the models. We suspect that this variable might not sufficiently capture workers' skill (for example, it does not take account of prior experience from employment in other firms).

The coefficient of firm age is negative and highly significant across all models. The marginal effect implies that doubling the age of the firm would reduce the probability of being in the higher innovation group by about 12.4 per cent all other variables remain constant. This is rather against our expectation. The reason is that in our data all the owners of the firms, but two, reported that they started their business from scratch. Hence, the firm age mainly captures experience of the owner as entrepreneur and is expected to be positively related with innovation. The negative and highly significant coefficient of firm age, however, could be explained by the fact that the innovative spirit of small firms might be higher in their early age and declines at the later stage of their life cycle.

We have also estimated alternative specifications in a further effort to check the robustness of our results. First, we make different classification of innovation activities, i.e. distinguishing between innovators (firms who take one or more innovation activities) and non-innovators (with no innovation activity), and high innovators (firms with three or more types of innovation) versus firms with less than three or no innovation activity at all. The two equations are separately estimated using univariate Probits and each is jointly estimated with the network equation. The results are reported in Table A1 (columns 2 and 3). Both estimations give similar results not only each other but also with the main model. The number of partners and length of relationship are positive and highly significant. The owner education also continues to be positive and significant in both estimations. Age of the firm is also negative and significant similar to the main specification. The only difference with the main specifications is that workers' tenure becomes significant in the model that differentiates innovators and non-innovators (column 2).

Second, despite our concern of complementarities and overlapping of the innovation activities we classified innovation activities into product innovation and process innovation and

estimated the two equations jointly with the same set of explanatory variables using a bi-variate Probit model and also jointly estimated with the network equation. We consider that there is product innovation when a firm increases its product variety or introduces better design, while the process innovation refers to increasing the quality of the product or machinery investment. The test result shows that the error terms in the two models are indeed positively and highly correlated justifying the joint estimation (see Table A1). The coefficients are not directly comparable with univariate estimations of probit models. The results are, however, generally consistent with the main model estimates when looking at the direction of causation and significance level of the variables. The network variable (number of partners) is positive and highly significant in the process innovation equation but becomes weaker in the product innovation. The length of relationship and owner education continue to be positive and highly significant in both process and product innovations. Unlike to the main model, both the estimations of product and process innovations yield positive and significant effect of workers' tenure (Wrk_tnr), while the age effect in these models becomes weaker.

Overall, the alternative models confirm the direction of the impacts of the explanatory variables, in particular the positive effect of networking and absorptive capacity and the negative effect of age.

6. Conclusions

Most of the empirical studies on the benefits of clusters have focused on meso level analysis with an implicit assumption that clustered firms are homogenous and equally benefit from the existence of spillovers and opportunities for joint action. This study attempts to understand the characteristics of innovation in clusters by focusing on micro level learning process, using recently collected firm level data on the Mercato footwear cluster in Ethiopia. It particularly examines the major channels through which the firms obtain new knowledge and the impact of firm heterogeneity in absorptive capacity and network embeddedness on their innovation performance.

The study shows that business interactions with buyers, suppliers and other producers are the major channels through which firms acquire knowledge. Business networks are thus not only centered on transactions of goods and services, but also constitute networks of knowledge flows into the cluster. The study also reveals that despite geographical proximity and homogeneity in social background there is a wide variation among firms in the way they are connected to local business networks. These networks are selective and based on mutual trust,

which in turn is built on long-term business interactions. Firms with strong positions in local business networks tend to perform well in terms of innovation. This supports the claim that what matters most for innovation in clusters is connectedness: co-location is simply not enough (Boschma and Wal, 2007). On the other hand, it contrasts the view that knowledge networks but not business networks are the source of heterogeneous performance among cluster firms (Giuliani, 2005).

The results further indicate that absorptive capacity (human capital), particularly the owner's education, improves innovation performance. The positive relation between absorptive capacity and innovation suggests that cluster performance is more likely to be enhanced by strengthening firms' knowledge bases rather than by pooling firms together in the same geographical area (Giuliani, 2006).

Similar to the Mercato footwear cluster, a great number of clusters in developing countries are largely constituted of small and informally operating firms that produce solely for the domestic market. The existing networks in such clusters are predominantly inward- looking with less extra-local knowledge connections. Hence, exposure to external knowledge through networking and provision of more training may enhance innovation and further upgrading of clusters by avoiding the lock-in effect in an increasingly obsolete technology (Camagni, 1991). However, successful upgrading of such clusters requires understanding of the factors that lead to heterogeneous performance in clustered firms.

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Table 1 Firm and entrepreneurial characteristics of the sample

Firm attributes	% of firms	Owner attributes	% of firms
Firms by employment category		Owner ethnicity	
up to 5	36.0	Guraghe	86.9
6-10	40.7	Others	13.1
11 – 20	13.3		
20 and above	10		
Firms by age category		Owner education completed	
up to 5	34.6	No formal school	2.0
6-10	42.5	Primary and junior high school	55.6
11 – 20	20.9	Senior high school	34.6
20 and above	2.0	Above high school	8
Firms produce shoes		Other owner characteristics	
Exclusively gentle men's	50.3	Owner mainly learn shoemaking on the job training	100
Exclusively ladies'	10.5	Owner's father know shoe making	21.6
Mix gentle men's, children's & ladies	39.2	Owner has a sibling in the shoemaking business	54.9
Other firm characteristics			
% of male owned firms	98.7		
Business is registered	23.5		
Have business licenses	12.42		

Note that all percentages are calculated based on the total number of firms in our sample, i.e. 153.

Table 2 Type and intensity of innovation activities in the cluster

	Count	%
Have you made important improvement/change to your business in the last three years (Yes**)**	128	83.3
If yes what was the major change (three major**)** [a]		
Increase quality of products	108	70.6
Better design	104	68.0
Machinery investment	39	25.5
Increase variety of products	39	25.5
Workers skill improvement	23	15.0
Managerial skill improvement	7	4.6
Better supply chain	7	4.6
New forms of distribution and marketing channel	4	2.6
Organizational modernization	3	2.0
Number of firms with		
Zero innovation activity	25	16.3
One innovation activity	2	1.3
Two innovation activities	49	32.0
Three innovation activities	77	50.3

[a] Note that the percentages do not add up due to the possibility of up to three multiple answers

Table 3 Business relations in the cluster

	By type of partner (%)	
Number of business partners the firm has permanent relation with	clients	suppliers
0	2.61	16.99
1-3	25.49	24.19
4-6	46.41	30.73
7-10	17.64	17.65
above 10	7.81	10.45
Average length of relationship (in months)		
1 - 12	19.6	23.51
13 - 24	16.33	18.93
25 - 36	24.17	20.9
36 - 48	6.53	18.95
Above 48	16.33	15.03
Relationship with main partner		
Relative or born in the same area	2.68	4.8
Working together for longer time	97.32	95.3
Location of the partners		
Inside the cluster	94.6	96.9
Outside the cluster	5.4	3.1

Table 4 Type and extent of collaboration in the cluster

	clients	suppliers	other producers	all
% of firms significantly or very significantly collaborate with partners on the following types of collaborations				
Information & experience exchange	60.1	30.1	23.5	
Quality improvement	58.2	30.7	18.9	
Setting product specification	19.7	6.5	2.6	
Design sharing	18.3	0.7	3.9	
Delivery conditions	42.5	13.1	-	
Working training			0	
Machine sharing			2	
Orders sharing			2.7	
Number of partners with whom the firm has co-operation on information and experience exchange				
0	7.19	45.8	49. 7	4.6
1 to 3	49.67	34.0	28.8	12.4
4 to 6	27.45	15.0	18.3	33.3
7 to 9	5.89	1.3	0.7	19.6
10 and above	9.8	3.9	2.6	30.1
Shapiro-Wilk W test on the number of partners collaborating on information and experience exchange				
W	0.89	0.89	0.92	0.92
Prob>z	0	0	0	0

Table 5 Definition of variables and some statistics

Variable name	Definition	Mean	Std. Dev.	Min	Max
INV	categorical variable measuring if the firm is involved in multiple innovative activities (0 = no innovation, 1 = two innovations, 2 = three innovations) between 2005-08	1.34	0.749	0	2
Product innovation	A dummy equals one if the firm increases product variety or introduced better design between 2005-08	0.76	0.430	0	1
Process innovation	A dummy equals one if the firm made quality improvement or machinery investment between 2005-08	0.80	0.403	0	1
ln(num_part)	log of the sum of the number of buyers, suppliers and other producers with whom the firm has collaboration on information and experience exchange	1.98	0.67	0	3.18
ln(num_part)^2	Square of log of number of partners	4.34	2.31	0	10.1
ln(leng_rel)	Log of the average length of the relationship the firm has with its permanent buyers and suppliers in months	0.11	0.08	0	0.37
Owner_edc	dummy indicating owner completed high school and more	0.42 [a]	0.496	0	1
ln(firm_age)	Log of the number of years since establishment	1.92	0.519	0.7	3.2
ln(wrk_tnr)	Log of average tenure of workers in the firm (months)	2.04	0.743	0	4.1
ethn_Grg	A dummy if the owner's ethnicity is Guraghe	0.87	0.338	0	1
siblings	A dummy if the owner of the firm has siblings in the shoemaking business in the cluster	0.55	0.499	0	1
emp_catg1	Size category with 1 to 4 employees including the owner	0.36 [a]		0	1
emp_catg2	Size category with 5 to 10 employees including the owner	0.39 [a]		0	1
emp_catg3	Size category with above 10 employees including the owner	0.25 [a]		0	1
Price_neg	dummy capturing if the firm makes negotiations to set price with its customers	0.27	0.444	0	1
ln(pairs_sh)	Log of the size of the firm measured by the number of pairs of shoes produced in 2005 (prior to sample period)	5.21	1.23	0	9.39
reg_share	share of sales directly to traders from regions	4.52	15.48	0	95

[a] denotes the share of firms that belong to each employment category.

Table 6 Innovation performance estimation results

Innovation equation: dependent variable ordered categorical innovation				Average marginal effects by innovation category calculated from the estimation of endogeneity corrected model column (II)		
Estimation method	Ordered probit	Ordered probit Simultaneous equation FIML		High innovation	Middle innovation	No innovation
	I	II	III	IV_a	IV_b	IV_c
ln(num_part)	0.654***	1.381***	1.826***	0.391***	-0.120***	-0.271***
	(0.167)	(0.253)	(0.491)	(0.061)	(0.025)	(0.070)
ln(num_part)^2			-0.128			
			(0.133)			
ln(leng_rel)	0.451***	0.385***	0.389***	0.109***	-0.033**	-0.076***
	(0.114)	(0.111)	(0.110)	(0.031)	(0.016)	(0.019)
Owner_edc	0.706***	0.584***	0.559***	0.166***	-0.051*	-0.115***
	(0.218)	(0.204)	(0.201)	(0.057)	(0.027)	(0.036)
ln(firm_age)	-0.422**	-0.439**	-0.439***	-0.124***	0.038**	0.086***
	(0.203)	(0.172)	(0.169)	(0.048)	(0.019)	(0.033)
ln(wrk_tnr)	0.224	0.185	0.153	0.052	-0.016	-0.036
	(0.141)	(0.121)	(0.122)	(0.034)	(0.012)	(0.023)
ethn_Grg	0.644**	0.414	0.401	0.117	-0.036	-0.081
	(0.304)	(0.274)	(0.268)	(0.077)	(0.029)	(0.051)
Siblings	-0.338	-0.285	-0.283	-0.081	0.025	0.056
	(0.212)	(0.180)	(0.177)	(0.051)	(0.018)	(0.035)
emp_catg2	0.0373	-0.0395	-0.0351	-0.011	0.003	0.008
	(0.224)	(0.186)	(0.182)	(0.053)	(0.016)	(0.037)
emp_catg3	0.134	-0.0837	-0.0149	-0.024	0.007	0.016
	(0.293)	(0.254)	(0.261)	(0.072)	(0.022)	(0.050)
μ1	1.564**	2.633***	2.919***			
	(0.634)	(0.608)	(0.645)			
μ2	2.804***	3.663***	3.931***			
	(0.655)	(0.562)	(0.613)			
LR test [i]	Chi2(9) = 12.3					
	p-value 0.197					
Network equation: dependent variable log of number of partners						
Price_neg		0.219**	0.222**			
		(0.106)	(0.104)			
ln(pairs_sh)		0.135***	0.132***			
		(0.0406)	(0.0409)			
reg_share		0.009***	0.009***			
		(0.003)	(0.003)			
Constant		1.168***	1.186***			
		(0.223)	(0.225)			
Rho_12		-0.587***	-0.61***			
		(0.203)	(0.192)			
Log likelihood	-124.1282	-263.329	-262.865			
No. observations	151	153	153			

Note that Rho_12 denotes the correlation between the errors terms of the innovation and network equations. Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

[i] The LR test is for the null that the coefficients are equal across categories (i.e. proportionality assumption). The p-value 0.197 suggests this assumption is not violated.

Table A1 Robustness checks for different categorization of innovation activities

Innovation equation					
Dependent variables	Innovation category	Innovators dummy	High innovators dummy	Process innovation dummy	Product innovation dummy
Estimation method	Ordered probit 2SLS [i]	Probit simultaneous equation FIML		Bi-variate probit simultaneous equation FIML	
	(1)	(2)	(3)	(4)	(5)
ln(num_part)	1.582***	1.637***	1.310***	1.085**	0.565
	(0.564)	(0.217)	(0.303)	(0.449)	(0.472)
ln(leng_rel)	0.525***	0.457***	0.325***	0.409***	0.348***
	(0.117)	(0.162)	(0.123)	(0.144)	(0.134)
Owner_edc	0.673***	0.620**	0.592***	0.639**	0.950***
	(0.254)	(0.316)	(0.227)	(0.298)	(0.289)
ln(firm_age)	-0.535**	-0.562**	-0.389**	-0.332	-0.434*
	(0.220)	(0.229)	(0.195)	(0.234)	(0.236)
ln(wrk_tnr)	0.204	0.458**	0.0432	0.591***	0.375**
	(0.159)	(0.213)	(0.130)	(0.203)	(0.178)
ethn_Grg	0.427	0.0365	0.527	-0.0886	0.463
	(0.340)	(0.348)	(0.328)	(0.408)	(0.393)
Siblings	-0.331	-0.198	-0.317	-0.00370	-0.0904
	(0.243)	(0.241)	(0.199)	(0.252)	(0.250)
Emp_size (5-10)	-0.0303	0.220	-0.0659	0.305	0.0619
	(0.241)	(0.255)	(0.209)	(0.288)	(0.285)
Emp_size (>10)	-0.109	-0.145	-0.0222	0.228	-0.185
	(0.343)	(0.311)	(0.291)	(0.411)	(0.356)
Constant		-3.47***	-3.24***	-3.12***	-1.84*
		(0.642)	(0.662)	(0.919)	(1.020)
μ1	3.067***				
	(1.176)				
μ2	4.283***				
	(1.196)				
The network equation dependent variable log of number of partners					
Price_neg		0.314***	0.182	0.296***	
		(0.100)	(0.115)	(0.110)	
ln(pairs_sh)		0.129***	0.138***	0.130***	
		(0.0423)	(0.0408)	(0.0468)	
reg_share		0.0084***	0.0097***	0.0087***	
		(0.00315)	(0.00304)	(0.00326)	
Constant		1.183***	1.165***	1.179***	
		(0.229)	(0.226)	(0.247)	
Rho_12		-0.77***	-0.576***	-0.432	-0.178
		(0.1696)	(0.238)	(0.316)	(0.312)
Rho_23				0.842***	
				(0.115)	
Log likelihood	-126.575	-182.328	-225.883	-246.0304	
No. observ.	151	153	153	153	

Note: Rho_12 denotes the correlation between the errors terms of the innovation and network equations in (1) and (2), while Rho_12, Rho_13 and Rho_23 are the correlations between the process innovation, product innovation and network equations in the bivariate probit simultaneous equations model (3) and (4); Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

[i] The standard errors in the second stage are bootstrapped to account for the fact that one of the regressors, ln(num_part), is the predicted value from a prior estimation.

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